Economic Staff Paper Series

Economics

12-2001

The Value of Consumers of Genetically Modified Food Labels in a Market with Diverse Information: Evidence from Experimental Auctions

Wallace E. Huffman
Iowa State University, whuffman@iastate.edu

Jason F. Shogren
University of Wyoming

Matthew Rousu
Iowa State University

Abe Tegene
United States Department of Agriculture

The Value to Consumers of Genetically Modified Food Labels in a Market with Diverse Information: Evidence from Experimental Auctions

Wallace E. Huffman, Jason F. Shogren,
Matthew Rousu, and Abe Tegene

December 2001

Staff Paper #345

The Value to Consumers of Genetically Modified Food Labels in a Market with Diverse Information: Evidence from Experimental Auctions

Wallace E. Huffman, Jason F. Shogren, Matthew Rousu, and Abe Tegene

Iowa State University

Staff Paper 345

The authors are professor, Department of Economics, Iowa State University; Stroock distinguished professor of natural resource conservation and management, Department of Economics and Finance, University of Wyoming; graduate student, Department of Economics, Iowa State University; and Program Leader and Agricultural Economist, Resource Economic Division, ERS, U.S. Department of Agriculture.

The authors gratefully acknowledge assistance from Daniel Monchuk and Terrance Hurley in conducting the auctions and assistance from Monsanto, in providing some of the products used in the experiment.

This work was supported through a grant from the Cooperative State Research, Education, and Extension Service, U.S. Department of Agriculture, under Agreement 00-52100-9617 and from U.S. Department of Agriculture, Economic Research Service, under agreement 43-3AEL-8-80125. Journal paper no. of the Iowa Agricultural and Home Economics Experiment Station, Ames, IA. Project 3077.

The Value to Consumers of Genetically Modified Food Labels in a Market with Diverse Information: Evidence from Experimental Auctions

Wallace E. Huffman, Jason F. Shogren, Matthew Rousu, and Abe Tegene

Abstract

When a food item might be genetically modified (GM) and divergent information about risks and benefits exists, do U.S. consumers value information provided by a label? This paper addresses this question by designing and conducting an experimental auction to elicit consumers' willingness to pay for both GM-labeled and standard-labeled foods. The evidence gathered for vegetable oil, tortilla chips, and potatoes shows that labels matter, and in particular, consumers were willing to pay about a 14 percent premium for food items they perceived as non-GM. We found that women and men have similar reactions to the GM-food labels, but the sequencing of food labels, i.e., seeing GM-labels first or second, was statistically significant. If consumers bid on foods with GM-food labels in the first of two rounds of bidding, they on average reduced their bids.

Key words: genetic modification, food labels, GM-foods, laboratory auctions, experimental economics, corn chips, vegetable oil, potatoes, willingness to pay, demand consumers

The growing genetically modified (GM) food controversy and consumers' attempts to make better food purchasing decisions have pressed GM-food labeling into an important public policy issue around the globe. In the United States, while truthful labeling has been used to provide consumers with information on calories, nutrients, and food ingredients, the federal government only requires explicit GM-labels if a GM-food has distinctive characteristics relative to the non-GM version. In contrast, the European Commission adopted genetically modified organism (GMO) food labeling in 1997. The Commission requires each member country to enact a law requiring labeling of all new products containing genetically modified organisms. In some European Union (EU) countries, information technologies have made it economically feasible to encrypt large amounts of information on food package bar codes. Japan, Australia, and many other countries have also passed laws requiring GM-labels for major foods. Labeling involves real costs--fixed costs of designing labels and testing -- and variable costs of monitoring for truthfulness. A critical open question is whether the social benefits from labeling are likely to exceed the cost?

This paper presents empirical evidence on U.S. consumers' willingness to pay for foods with and without GM-labels using laboratory auction experiments for three food items. In an experimental auction with divergent information about risks and benefits, we examine whether consumers value information provided in GM-labels. Following Fox *et al.* (2001), we create the divergent information design by providing six combinations of pro-GM, anti-GM, and third party perspectives, which provide their corresponding views on the scientific impact, human impact, financial impact, and environmental impact of GM-foods. The participants are actual consumers randomly chosen in two major Midwestern U.S. cities by the Iowa State University (ISU) Statistics Department. They were paid to participate in experiments on food and household products. Herein we report tests of the following hypotheses: Holding consumer tastes constant, (H1) GM-labels have no effect on consumers' willingness to pay for food items, (H2) no difference exists in consumers' willingness to pay for food items due to the GM-food-label treatment sequence, i.e., whether consumers first bid on foods with or without GM-food labels, and (H3) the effects of GM-food labels on willingness to pay for food items are the same for male and female consumers.

Background on Costs and Benefits of GM-Labels

The U.S. issued regulations in 1992 (Department of Health and Human Services) stated that GM-food did not have to be labeled if the food product had the same characteristics as their non-GM counterparts. In January 2001, the U.S. Food and Drug Administration (FDA) issued a "Guidance for Industry" statement for labeling GM products. The FDA agreed that the only GM-foods needing to be labeled are foods having different characteristics from the non-GM version. For firms that choose to label their GM-foods, the FDA has recommended guidelines that should be followed. For example, the FDA prefers that GM foods are not labeled as "genetically modified." Consumer surveys by the FDA found that this label misleads consumers into thinking the product has different characteristics. Rather the FDA prefers that foods be labeled as "genetically engineered" or "made using genetic modification" instead. Canada has a similar policy as the United States. Canada requires labeling only if there are health or safety issues.

The European Union has a de facto moratorium on the approval of any new GM-foods which has been in place since April 1998. The EU first implemented a mandatory labeling policy on GM-foods in 1997 and modified the standard in January 2000. If any ingredient in the food is at least one percent GM, the food must be labeled "genetically modified." In February 2001, the European Parliament voted for stricter regulations. The new regulations require stricter labeling and monitoring of GM products, and establishing methods for tracing GM products through the food chain (CNN). These new regulations, however, do not eliminate the moratorium.

Australia and New Zealand implemented standards that took effect in December 2001 (Australia-New Zealand Food Authority, October 2000). The new standards require "labeling of food and food ingredients where novel DNA and/or novel protein is present in the final food." Labeling is not required if no ingredient in a food product is more than one percent genetically modified. Also, labeling is not required for highly refined foods, foods that used GM processing aids that are not present in the final food, or food served in restaurants. If it is an ingredient in a product that is genetically engineered, the ingredient that is modified must be labeled as "genetically modified" in the list of ingredients. For a single ingredient GM-food, the phrase "genetically modified" must be listed on the front of the packet, next to the name.

In Japan, no labeling was required for GM products before April 2001, but on April 1, 2001, a new policy was implemented. This policy requires labeling of products that have at least five percent GM content. If the GM content is less five percent, firms have the option to label products voluntarily. For products that are labeled, producers must label the product as "genetically modified," "inseparable," or "no GMOs present" (Bernauer, 2001).

Until early 2001, China supported biotechnology. But now China's policy towards GM-foods has become more reserved. First, China banned GM rice, wheat, maize, tomato, cotton, and soybeans (*AgBiotech Reporter*, May 2001). On May 23, 2001, China issued a new, 56 article listing regulation policy on biotechnology. This article aimed at strengthening control over all aspects of agricultural biotechnology. A report by the U.S. Foreign Agricultural Service stated that "the regulation is vaguely worded, leaving a great deal to the discretion of the department responsible for drafting and enforcing the implementing regulations." The report goes on to say that there will be safety certification for all GM-food, and all GM-foods will have to be labeled (*AgBiotech Reporter*, July 2001).

Caswell (1998, 2000) has shown that many policies are possible, including mandatory labeling of GM-foods, voluntary labeling of GM-foods, or bans on all labeling to indicate whether a food is genetically modified. The policies that each country chooses are likely to be determined by the information demanded by the consumers of each country. An informed decision on whether to implement a labeling policy on genetically modified foods should only be done after a benefit/cost analysis.

Benefits of GM-Labels

Greenpeace and Friends-of-the-Earth both advocate labels on GM-foods to give consumers the right to choose whether to consume GM-foods. Many environmental and consumer advocacy groups call for mandatory labeling, which they believe benefits consumers.

The United States Department of Agriculture (USDA), Economic Research Service (2000), has analyzed the potential benefits of food labels. One benefit is making it easy for consumers to find information, e.g., nutritional content of foods. Thus, food labeling can lead to more informed choices on food and health by consumers. Also, some firms may want to avoid the prospect of a label giving incorrect signals to consumers and others.

Caswell and Padberg (1992) recommended a comprehensive view of the benefits of labels on food products. They suggest these benefits are larger than normally discussed.

Potential benefits from food labels include increased consumer information, improved product design, and more consumer confidence in product quality. Also, labels provide an option value, even for consumers who do currently read food labels. This option value exists because if a food is labeled, consumers always have the option to view the label, either now or in the future, and that option has some value. But these optimistic positive effects did not occur in Switzerland. When Switzerland implemented GM-food labeling, the GM-foods became the target of anti-biotech political forces. Consumer demand was dramatically reduced for these food products and the GM-foods are no longer in the market or an option for consumers.

Costs of GM-Labels

Implementing a labeling policy could be costly. The United States Department of Agriculture, Economic Research Service (2000) considered the range of costs associated with implementing a labeling policy. If a mandatory labeling policy on genetically modified foods is enacted, significant costs would be incurred. Identity preservation, to determine whether a particular food is GM, has substantial fixed costs. When separating GM from non-GM-foods, mistakes in delivery of the product are a possibility. In the United States, for instance, a type of GM corn that was banned for human consumption, known as Starlink corn, got into the U.S. food system. Another possible cost is accidental contamination of non-GM crops by their GM counterpart. Farmers have to go to great lengths to ensure that non-GM crops are not contaminated with the GM variety. To avoid contamination, farmers need buffer zones, i.e., zones between the GM and non-GM crops to lower the probability of contamination. Farmers also must thoroughly clean planting and harvesting equipment between GM and non-GM uses. All items imply real supply-side costs when a labeling policy is implemented.

In addition, the added label and storage costs would lead to higher prices for consumers (and possibly lower prices to producers). The higher prices would affect all consumers, and act like a regressive tax. Poor people spend a larger share of their income for food than do high-income households. Also, the poor and less educated are less likely to benefit from food labels. This leads to what the USDA labeled, a "reverse Robin Hood effect" of taking money from the poor to benefit the rich.

The USDA suggests that labeling could also change an industry's structure. With some fixed costs associated with labeling, small firms may have higher per unit labeling costs than large firms. This creates increasing returns to scale and an incentive for firms to become bigger, or close down. A labeling policy that decreases the number of firms could decrease competition and could again increase prices for consumers. Another cost firms could face is reformulation costs, which could be significant.

The USDA also suggests that adding more information to food labels dilutes the other information given on the label. This concern seems most important when the labeling policy being considered would inform consumers of an attribute that may not impact human health, e.g., genetic modification. Labeling without independent verification is unlikely to be useful. Hence, a new labeling policy would require resources for government or third-party verification.

That said, there are relatively few estimates of the cost for labeling GM-foods. KPMG was commissioned for a study in Australia and New Zealand to examine the costs of complying with a new labeling law. They estimated that the costs of the labeling laws could mean an increase in consumer prices from 0.5 to 15 percent, and that firms could also face lower profits (Phillips and Foster). Even though they commissioned the study, the Australian and New Zealand Food Standards Council later disregarded KPMG's input, citing flaws in the study.

Whether this council had legitimate problems with the study, or were taking the politically expedient path, we do not know. In a study of Canada, Phillips and Smyth (1999) estimated that a voluntary identity preserved production and marketing system in Canada cost from 13-15 percent during 1995-1996. One thing seems apparent; implementing a labeling policy on genetically modified foods is costly, and involves uncertain effects on, firms, consumers, and the industry.

Experimental Design

The on-going GM-food debate has been fueled by information provided by the interested parties. The biotech industry has provided a positive perspective on agricultural biotechnology, while environmental or anti-technology groups have supplied the negative perspective. Each perspective is trying to affect the demand for GM-foods and inputs in a particular direction. In such a contentious environment, an independent, third-party perspective which provides verifiable information to consumers and farmers might be social welfare improving (Huffman and Tegene, 2000). Such a verifiable information source, however, would be costly to produce and to manage effectively.

With this general background in mind, we designed a research project to incorporate the private-information-revealing feature of experimental auction markets and the rigorous randomized treatment design of statistical experimental design (see for example Hoffman *et al.* 1993, Fox *et al.* 1998, Shogren *et al.* 2000, Lusk *et al.* 2001).[1] The primary purpose of the project was to identify the effects of positive, negative, and verifiable information about biotechnology on consumers' willingness to pay for food items that might be genetically modified. We designed a set of experimental auctions in which consumers bid on actual foods that differed only by the presence or absence of GM-food labels.

The experimental design consisted of six biotech information-labeling treatments with two replications. The treatments were randomly assigned to twelve experimental units, each consisting of 13 to 16 consumers drawn from the households of two major urban areas and who were paid to participate. We anticipated that a sample size of 165 to 190 participants was necessary for finding statistically significant results, which was not prohibitively costly. Using randomly chosen consumers from the population of an urban area, rather than undergraduate college students at a university, is seen as an advantage when it comes to making inferences, however cautious, from the experiments to the Midwest or whole U.S. population (also see the comments in Lusk *et al.* 2001). Conducting experiments in two urban areas rather than one is also seen as enhancing credibility of our results by showing that the experiments can be replicated across urban areas.

We now describe the four elements in our GM labeling experiments—the GM food, the auction mechanism, the experimental units, and the specific steps in the experiment (which includes the detailed information labels). Consider each in turn.

The GM Food

We anticipated that consumers might react differently to GM content for foods of different types. Believing that one food item was unlikely to reveal enough information, we settled on three items: vegetable oil (made from soybeans), tortilla chips (made from yellow corn), and Russet potatoes. In the distilling and refining process for vegetable oils, essentially all of the proteins (which are the components of DNA and source of genetic modification) are removed leaving pure lipids. Minimal human health concerns should arise from consumption of the oil, but people might still fear that GM soybeans could harm the natural environment. Tortilla chips are highly processed foods that may be made from GM or non-GM corn, and consumers might have human health or environmental concerns or both. Russet potatoes are purchased as a fresh product and generally baked or fried before eating. Consumers might reasonably see the potential concentration of genetic modification as being higher in potatoes than in processed corn chips. Consumers might see both human health and environmental risks from eating Russet potatoes.

The Random *n*th-price Auction

Valuation experiments use an auction mechanism to induce people to reveal their preferences for new goods and services (e.g., see Shogren *et al.* 1994, Fox *et al.* 1998, and Shogren *et al.* 2000). In particular, Vickery's (1961) sealed bid, second-price auction has been a popular mechanism. The popularity of the second-price auction mechanism is largely due to it being demand revealing in theory, being relatively simple to explain, and having an endogenous market-clearing price.[2] Also, evidence from induced value experiments suggests the auction mechanism can produce efficient outcomes in the aggregate (Kagel 1995). A problem with the second-price auction, however, is that it does not always engage the bidders who anticipate being *off the margin*, i.e., bidders whose value for a good is far below or above the market-clearing price. These bidders have a low opportunity cost from an insincere bid, making it difficult to measure accurately the entire demand curve for a real-world good like GM-food (see Miller and Plott, 1985; Franciosi *et al.* 1993). Insincere bidding can be sustained if the behavior is undetected and unpunished by the institutional structure of the auction mechanism (see Cherry *et al.* 2001).

We chose the random *n*th-price auction for our GM-food experiments because it is designed to engage both the on- and off-the-margin bidders (see Shogren *et al.* 2001). The auction combines elements of two classic demand-revealing mechanisms: the Vickrey auction and the Becker-DeGroot-Marschak (1964) random pricing mechanism. The key characteristic of the random *n*th price auction is *a random but endogenously determined* market-clearing price. Randomness is used to give all participants a positive probability of being a purchaser of the auctioned good; the endogenous price guarantees that the market-clearing price is related to the bidders' private values.

The random *n*th-price works as follows. Each of k bidders submits a bid for one unit of a good; then each of the bids is rank-ordered from highest to lowest. The auction monitor then selects a random number—the n in the *n*th-price auction, which is drawn from a uniform distribution between 2 and k, and the auction monitor sells one unit of the good to each of the n-1 highest bidders at the *n*th-price. For instance, if the monitor randomly selects $n = 4$, the three highest bidders each purchase one unit of the good priced at the fourth-highest bid. *Ex ante*, bidders who have low or moderate valuations now have a nontrivial chance to buy the good because the price is determined randomly. This auction increases the probability that insincere bidding will be costly (Shogren *et al.* 2001).

The Experimental Units

Auctions were planned and conducted at two Midwestern U.S. cities, Des Moines, IA, and St. Paul, MN. Participants in the auctions were consumers that the Iowa State University Statistics Laboratory contacted and obtained agreement to participate. The Statistics Laboratory obtained 1,200 to 1,500 randomly selected residence telephone numbers from each of the metropolitan areas. These numbers were called by an employee of the ISU Statistics Laboratory to make sure that it was in fact a residence, and then asked to speak to an adult in the household (person who was 18 years of age or older).[3] They were told that Iowa State University was looking for people who were willing to participate in a group session in Des Moines (St. Paul) that related to how people select food and household products. The sessions were held on Saturday, April 7th (April 21st), 2001, and people were informed that the sessions would last about 90 minutes. They were also told that at the end of the session each participant would receive $40 in cash for their time. The sessions were held at the Iowa State University Learning Connection, 7th and Locust Street, Des Moines (and lower level of the Classroom Office Building, University of Minnesota, St. Paul). Three different times were available each auction day, 9 am, 11:30 am, and 2 pm, and willing participants were asked to choose a time that best fit their schedule. Participation per household was limited to two adult individuals, and they were assigned to different groups.[4] To willing participants, the Statistics Laboratory followed up by sending a letter containing more information, including a map and instructions on when and where the meeting would be held, directions for getting there, and a telephone number to contact for more information.

There were twelve experimental units, six in Des Moines, and six in Minneapolis. People who were called had the option of participating at one of three experimental auction starting times: 9 am, 11:30 am, and 2 pm. Twelve hundred people in Des Moines were called and 99 of them agreed to participate. Of those who agreed to participate, 78 actually did. For the Minneapolis experiments, 1,500 people were called and 118 people agreed to participate. Of those who agreed, 96 actually did. Our total sample size of participants is 174.

Steps in the Experiment

Figure 1 shows the ten specific steps in each experimental unit.[5] In step 1 when participants arrived at the experiment, they signed a consent form agreeing to participate in the auction. After they signed this form, they were given $40 for participating and an ID number to preserve the participants' anonymity. The participants then read brief instructions and filled out a questionnaire.

In step 2, participants were given detailed instructions about how the random *n*th-price auction works, including an example written on the blackboard. After the participants learned about the auction, a short quiz was given to participants to ensure that everyone understood how the auction worked. All experimental instructions are available from the authors on request.

Step 3 was the first practice round of bidding, in which participants bid on a brand-name candy bar. The participants were all asked to examine the product, and then place a bid on the candy bar. The bids were collected and the first round of practice bidding was over. Throughout the auctions, when the participants were bidding on items in a round, they had no indication of what other items they may be bidding on in future rounds.

Step 4 was the second practice round of bidding, and in this round the participants bid separately on three different items. The products were the same brand-name candy bar, a deck of playing cards, and a box of pens. Participants knew that only one of the two rounds would be chosen at random to be binding, which prevented anyone from taking home more than one unit of any product. Following Melton *et al.* (1996), this random binding round eliminates the threat of a person reducing his bids due to him potentially buying more than one unit.[6] The consumers first examined the three products and then submitted their bids.

After the two practice auction rounds were completed, the binding round and the binding *n*th-prices were revealed in step 5. All bid prices were written on the blackboard, and the *n*th-price was circled for each of the three products. Participants could see immediately what items they won, and the price they would pay. The participants were told that the exchange of money for goods was in another room nearby, and would take place after the entire experiment was completed.

In step 6, participants received one of six potential *info-packets* that provided non-food-label information about biotechnology. These info-packets were produced as follows. We created three information sources: (1) the *industry perspective*—a collection of statements and information on genetic modification provided by a group of leading biotechnology companies, including Monsanto and Syngenta; (2) the *environmental group perspective*—a collection of statements and information on genetic modification from Greenpeace, a leading environmental group; and (3) the *independent, third party perspective*—a statement on genetic modification approved by a third party group, consisting of a variety of people knowledgeable about genetically modified goods, including scientists, professionals, religious leaders, and academics, who do not have a financial stake in genetically modified foods. We limited each information source to one full page, organized into five categories: *general information, scientific impact, human impact, financial impact,* and *environmental impact*. Figures 2-4 show the exact format and wording of the three information sources.

These information sources were then randomized to create the six *info-packets*: (1) pro-biotechnology, (2) anti-biotechnology, (3) both pro and anti-biotechnology,[7] (4) pro-biotechnology and independent, verifiable,[8] (5) anti-biotechnology and independent, verifiable, and (6) pro-biotechnology, anti-biotechnology, and independent verifiable. These info-packets were then randomized among all twelve experimental units, with each info-packet going to two experimental units.

Once the appropriate info-packet was distributed to the participants in a given unit, two auction rounds were then conducted. The rounds were differentiated by the food label—either the food had a *standard food label* or a *GM-label*, as shown in Figure 5. In one round (which could be round 1 or 2 depending on experimental unit),[9] participants were bidding on the three food products each with the standard food label. We made these labels as plain as possible to avoid any influence on the bids from the label design. In the other round, participants were bidding on the same three food products with a GM-label, which differed from the standard label by the inclusion of only one extra sentence: "This product is made using genetic modification (GM)." We constructed the GM-labels to comply with the U.S. Food and Drug Administration regulations of GM-food labels. For each experimental unit, participants knew that only one round would be chosen as the binding round that determined auction winners.

In step 7, participants bid on three different food products: a bag of potatoes, a bottle of vegetable oil, and a bag of tortilla chips, either with the standard or GM-label. The participants were instructed to examine the three products, and then to write down their sealed bid for each of the three goods. Participants bid on each good separately. The monitor then collected the bids from the people, and then told them they were next going to look at another group of food items.

Step 8 had participants examine the same three food products, each with a different label from round 1. Again the participants examined the products, and bid on the three products separately. The bids were then collected from all of the individuals.

Step 9 selected the binding round, and the binding random *n*th-prices for the three goods. Winners were notified. Each participant was asked to complete a brief post-auction questionnaire. In step 10, the monitors dismissed the participants who did not win. The monitors and the winners then exchanged money for goods, and then they were dismissed.

Data and Results

Table 1 summarizes the demographic background of the 172 participants who had complete information. Sixty-two percent of the participants were female and the mean age of our participants was 49.5 years. Two-thirds of the participants were married, and on average, the participants were well educated, with the mean schooling being greater than two years of college. The participants had a mean total household income level (before taxes) of $57,000. Most of the participants in the experiments were white (ninety percent), and most participants indicated that they read labels before they buy a new food product. The demographic characteristics of our participants match well the attributes of the sampled areas.

Table 2 shows the mean bids for each of the three products, the 5-pound bag of potatoes, the 32-ounce bottle of vegetable oil, and the 1-pound bag of tortilla chips. Table 2, Part A, shows the mean bids for all participants. For each of the three food products, participants were willing to pay less when the product had the GM-label than when it had the standard food label. Table 2, Part B, shows the bids for the subset of auction participants who bid on food products having GM-food labels in round 1, and Part C shows the bids for participants who bid on food products having the GM-labels in round 2. The bids for the GM-labeled and standard label food are much closer when participants bid first on GM food (round 1) compared to those who bid on GM-labeled food second (round 2). One explanation for this result is that when participants bid on food with GM-food labels in round 1, they imagine the products in round 2 are also genetically modified and bid accordingly. In contrast, participants who bid on plain-labeled foods in round 1 had less reason to suspect that these products were GM; they then lowered their bids once the GM-labeled food was auctioned in round 2.

We tested our three specific hypotheses using a regression model. Recall: Holding consumer tastes constant, (H1) GM-labels have no effect on consumers' willingness to pay for food items, (H2) no difference exists in consumers' willingness to pay for food items due to the GM-food-label treatment sequence, and (H3) the effects of GM-food labels on willingness to pay for food items are identical for male and female consumers.

With our experimental unit design, the modeling is straightforward. The dependent variable is the difference in bid prices for a commodity without and with GM-food labels, in which the individual bid price is designated as "non-labeled" and "labeled:"

$$P_i^{non-labeled} = \beta_1^{non-labeled} + \beta_2^{non-labeled} X_{i2} + \mu_i^{non-labeled} \tag{1}$$

$$P_i^{labeled} = \beta_1^{labeled} + \beta_2^{labeled} X_{i2} + \mu_i^{labeled}, \tag{2}$$

where P_i represents the price bid for a good by participant i; β_1 is an intercept term; X_{i2} is a vector of socio-demographic variables, and β_2 is the associated vector of coefficients, and μ_i is a random error term. Equations (1) and (2) can be rearranged to obtain an equation for the difference in bid prices for a given product and participant:

$$P_i^{non-labeled} - P_i^{labeled} = \beta_1^{non-labeled} - \beta_1^{labeled} + \left(\beta_2^{non-labeled} - \beta_2^{labeled}\right) X_{i2} + \mu_i^{non-labeled} - \mu_i^{labeled} \tag{3}$$

or

$$P_i^{non-labeled} - P_i^{labeled} = \beta_1^* + \beta_2^* X_{i2} + \mu_i^* \tag{4}$$

When equation (3) is fitted by least squares, β_1^* and β_2^* are estimates of *differences* between coefficients in equations (1) and (2). The dependent variable in all of the regressions is a person's difference in bids for a food with a standard label and food with a GM-label. Note that using the difference specification in equation (4) eliminates individual fixed effects, e.g., tastes. The dependent variable will contain a relatively large amount of noise, and the R^2 for the fitted equation will be "smaller."[10]

Three sets of tables of results are reported, one set for each of the three products—the potatoes, the tortilla chips, and the vegetable oil. "Labels1" is a dummy variable taking a value of 1 if an experimental unit bid on foods with GM-labels in round 1 (and standard-labeled foods in round 2). The other two explanatory variables are household income and gender. Gender is a dummy variable taking a value of 1 if a person is female.

Tables 3, 4, and 5 report the regression results for vegetable oil, tortilla chips, and potatoes. Regression (1) reports a test of the difference in bid prices due to GM-labels. The intercept is positive implying that on average, participants were willing to pay 14 cents less for a 32-ounce bottle of vegetable oil labeled as genetically modified, 15 cents less for a 1-pound bag of tortilla chips labeled as genetically modified, and 13 cents less for a 5-pound bag of Russet potatoes labeled as genetically modified. All three intercept terms are statistically significant at the 1 percent level. We therefore reject hypothesis H1: GM-labels had a significant effect on consumers' willingness to pay for each food item.

This result differs from that found in Lusk *et al.*'s (2001) GM-food experiment, in which the majority of auction participants, who were students at Kansas State University, were unwilling to pay a premium for non-GM corn chips. They did, however, find a subset of student bidders, about 20 percent, willing to pay at least \$0.25/oz to exchange their GM-chips for non-GM-chips. Lusk *et al.* recognize the uniqueness of their sample, and they conclude by speculating that "if experiments were conducted with a larger, potentially more representative sample, we would expect a larger percentage of participants to bid [for non-GM food], and bid at higher levels." Our results confirm their expectations—the average adult in a major Midwestern city was willing to pay about a 14 percent premium for the food they perceived as non-GM.

In regression (2), the difference in bid prices is regressed on an intercept term and the variable "labels1." The coefficient of this dummy variable is negative for all three products, indicating that participants who bid on the GM-labeled food in the first round paid a smaller premium for plain-labeled food than the other participants. The premium for vegetable oil was 17 cents smaller, for tortilla chips the premium was 11 cents smaller, and for potatoes the premium was 19 cents smaller for participants who bid on food products with GM-labels in round one. The coefficient of the dummy variable for "labels1" was statistically significant for two of the three products.[11] Therefore, we reject Hypothesis H2 for two foods—a significant difference did exist in consumers' willingness to pay for vegetable oil and potatoes when they first bid on foods with GM-food labels.

Regression (3) is used for testing household income effects on the bid price difference. For these regressions, the coefficient of income was positive but not statistically significant (5 percent level). Regression (4) included gender as an explanatory variable. The coefficient of gender is negative for all three products, indicating that women pay a smaller premium for plain-labeled-foods. This coefficient, however, is not significantly different from zero (5 percent). Regression (5) includes both income and gender as explanatory variables, and neither coefficient was significantly different from zero in these equations.[12] Therefore, we do not reject Hypothesis H3: GM-food labels had the same effect on willingness to pay for male and female consumers.

The results from our experiments are noteworthy. People, on average, paid about a 14 percent premium to purchase food they perceived as non-GM. The premium was similar across the three food products, suggesting that most people perceive net GM-effects similarly for the three goods. The observation that a large premium exists for standard labels has implications from the industry perspective that strongly opposes GM-labeling on food.

We suggest two interpretations. First, without the GM-labels, consumers are paying an implicit tax by bidding more for food than they otherwise would. GM-food labels would therefore benefit consumers by informing them of GM content, which lowers their bid. An alternative interpretation is that consumers do not understand genetic modification, and given genetically modified food products are deemed as "substantially equivalent" to their non-GM counterparts, consumers' would be better off by not being exposed to GM-labels. If this is the case, more information on the risks or benefits of GM-foods could help consumers make more informed decisions. Whatever the explanation for this might be, it is apparent that consumers' demand for GM-foods is significantly lower than the demand for the non-GM counterpart.

Conclusion

This study has shown that consumers' willingness to pay for a food product decreases when the food label indicates that a food product is genetically modified. Consumers were willing to pay about a 14 percent premium for food items they perceived as non-GM. In addition, gender, income, and other demographic characteristics do not appear to alter a consumer's willingness to pay for genetically modified foods. This paper has also shown that the order in which consumers bid on food, i.e., whether they bid on the food with GM-labels in round one or round two has a significant impact on the willingness to pay for GM-foods. Participants who bid on food with GM-labels in round 1 had a much higher willingness to pay for GM-food than the participants who bid on food with GM-food labels in round 2.

The implications of this study are notable given the on-going global controversy over the issue of labels on genetically modified foods. This debate has forced many countries around the world to consider or to implement new food labeling policies. Given that the average adult consumer in a major Midwestern city did reveal a significant premium for foods they perceive as non-GM, a mandatory GM labeling policy seems unlikely to be in the best interest of the biotechnology industry but may be in the interest of consumers.

Future research will examine the effects of different types of information on consumers' willingness to pay for foods that might be genetically modified. Another avenue for future research could examine how consumers react to GM-foods that have specific benefits. Our food products in these auctions were modified and deemed substantially equivalent to the conventional commodity. Some GM-foods have been modified to enhance the quality (e.g., protein, fat, sugar content, shelf life) of the product. Two such products are flavor-saver tomatoes that were genetically engineered to have a longer shelf life, and "golden rice," which was genetically modified to provide more vitamin A, which has potential benefits to people in Third World countries.

References

AgBiotech Reporter Vol 18, No. 2 February 2001.

AgBiotech Reporter Vol 18, No. 4 April 2001.

AgBiotech Reporter Vol 18, No. 5 May 2001.

AgBiotech Reporter Vol 18, No. 7 July 2001.

Australia-New Zealand Food Authority. "Genetically Modified Foods" (May 2001) http://www.anzfa.gov.au/GMO/.

Australia-New Zealand Food Authority. "Labelling Genetically Modified Foods: Compliance Guide to Standard A18."http://www.anzfa.gov.au/whatsinfood/gmfoods/ complianceguidea18gm.cfm., October 2000.

Becker, G., M. DeGroot and J. Marschak. "Measuring Utility by a Single Response Sequential Method." *Behavioral Science* 9 (1964):226-236.

Bernauer, Thomas. "Agricultural Biotechnology: Why do Regulations in the European Union, the United States, and Japan Differ?" Center for International Studies, Swiss Federal Technical Institute, Zurich, June 2001.

Caswell, Julie A. "Should Use of Genetically Modified Organisms Be Labeled?" *AgBioForum*, 1 (1998):22-24. http://www.agbioforum.missouri.edu.

Caswell, Julie A. "Labeling Policy for GMOs: To Each His Own?" *AgBioForum*, 3 (2000):53-57. http://www.agbioforum.missouri.edu.

Caswell, Julie A. and Daniel I. Padberg. "Toward a More Comprehensive Theory of Food Labels." *American Journal of Agricultural Economics* 74 (May 1992):460-467.

Cherry, T., T. Crooker, and J. Shogren. "Rationality Spillovers." *Journal of Environmental Economics and Management* (2001, forthcoming).

CNN. "Europe Approves Tough GM-Food Rules" (Feb. 14, 2001) http://www.cnn.com/2001/WORLD/europe/02/14/eu.gm/index.html.

Department of Health and Human Services, Food and Drug Administration. "Statement of Policy: Foods Derived From New Plant Varieties: Notice." *Federal Register*. 57 May 1992.

Economic Research Service, U.S. Department of Agriculture. "Economics of Food Labeling." *Agricultural Economic Report* No. 793. (December 2000).

Fox, John A., Dermot J. Hayes, and Jason F. Shogren. "Consumer Preferences for Food Irradiation: How Favorable and Unfavorable Descriptions Affect Preferences for Irradiated Pork in Experimental Auctions." *Journal of Risk and Uncertainty*, (2001, forthcoming).

Fox, John A. Jason F. Shogren, Dermot J. Hayes, and James Kliebenstein. "CVM-X: Calibrating Contingent Values with Experimental Auction Markets." *American Journal of Agricultural Economics* 80, (1998):455-465.

Franciosi, R., R. M. Isaac, D. Pingry, and S. Reynolds. "An Experimental Investigation of the Hahn-Noll Revenue Neutral Auction for Emissions Licenses." *Journal of Environmental Economics and Management*, 24 (1993):1-24.

Friends of the Earth. "The Need for Labeling Genetically Engineered Foods." (March 2001) http://www.foe.org/safefood/factshtgelabel.htm.

Galang Jr., Jose M. "Market Forces, Rise and Shine." (March 2001) http://www.monsantoindia.com/news/archives/march2001/050301.html.

Greenpeace International. "We Want Natural Food!" (March 2001) http://www.greenpeace.org/~geneng/.

Herrmann, Robert O., Rex H. Warland, and Arthur Sterngold. "Who Reacts to Food Safety Scares? Examining the Alar Crisis." *Agribusiness* 13 (1997):511-520.

Hoffman, E., D. Menkhaus, D. Chakravarti, R. Field, and G. Whipple. "Using Laboratory Experimental Auctions in Marketing Research: A Case Study of New Packaging for Fresh Beef." *Marketing Science*, 12 (1993):318-338.

Huffman, Wallace E. and Abebayehu Tegene. "Public Acceptance of and Benefits from Agricultural Biotechnology: A Key Role for Verifiable Information." Paper presented to the International Consortium on Agricultural Biotechnology Research (ICABR) on "The Economics of Agricultural Biotechnology" Ravello, (Italy) August 24-28, 2000.

Lusk, J., M.S. Daniel, D. Mark, and C. Lusk. "Alternative Calibration and Auction Institutions for Predicting Consumer Willingness to Pay of Nongenetically Modified Corn Chips." *Journal of Agricultural and Resource Economics* 26(July 2001):40-57.

McClusky, J. "A Game Theoretic Approach to Organic Foods: An Analysis of Asymmetric Information and Policy." *Agricultural and Resource Economics Review* 29 (April 2000):1-9.

Melton, B. E., W. E. Huffman, J. F. Shogren, and J. A. Fox. "Consumer Preferences for Fresh Food Items with Multiple Quality Attributes: Evidence from an Experimental Auction of Pork Chops." *American Journal of Agricultural Economics* 78 (November 1996): 916-923.

Miller, G. and C. Plott. "Revenue Generating Properties of Sealed-bid Auctions: An Experimental Analysis of One-price and Discriminative Actions." V. Smith, ed., *Research in Experimental Economics*, Vol 3 (JAI Press, Inc., Greenwich, CT), (1985):159-182.

Phillips, Peter W.B. and Heather Foster. "Labeling for GM-Foods: Theory and Practice." Paper presented to the International Consortium on Agricultural Biotechnology Research (ICABR) on "The Economics of Agricultural Biotechnology" Ravello, (Italy) August 24-28, 2000.

Phillips, Peter W.B. and Stuart Smyth. "Competitors Co-Operating: Establishing a Supply Chain to Manage Genetically Modified Canola." Presentation to the Economics of Quality Control in Agriculture Conference (1999).

Runge, C. Ford and Lee Ann Jackson. "Negative Labeling of Genetically Modified Organisms (GMOs): The Experience of rBST." AgBioForum 3 (2000) 310-314 http://www.agbioforum.missouri.edu.

Shogren, Jason F., John A. List, and Dermot J. Hayes. "Preference Learning in Consecutive Experimental Auctions." *American Journal of Agricultural Economics* 82 (November 2000):1016-21.

Shogren , Jason F., Michael Margolis, Cannon Koo, and John List. "A Random *n*th-Price Auction." *Journal of Economic Behavior and Organization* 46 (December 2001):409-421.

Smyth, Stuart and Peter W.B. Phillips. "Science and Regulation: Assessing the Impacts of Incomplete Information and Information in the Global Agricultural Biotechnology Industry." Paper presented to the International Consortium on Agricultural Biotechnology Research (ICABR) on "The Economics of Agricultural Biotechnology" Ravello, (Italy) August 24-28, 2000.

Tambling, Grant. "Labelling of Genetically Modified Food." (Retrieved May 2001) http://www.anzfa.gov.au/documents/mr24_99.asp.

U.S. Food and Drug Administration. "Guidance for Industry: Voluntary Labeling Indicating Whether Foods Have or Have Not Been Developed Using Bioengineering." (January 2001) http://vm.cfsan.fda.gov/~dms/biolabgu.html.

Vickrey, William. "Counterspeculation, Auctions, and Competitive Sealed Tenders." *Journal of Finance* 16 (March 1961):8-37.

Footnotes

[1] Phil Dixon and Wayne Fuller, Department of Statistics, Iowa State University, provided assistance with the statistical design part of the project.

[2] A key distinction between experimental economics and experimental psychology is that participants in economics experiments must be willing to back their stated preferences for a good by a real economic commitment. In psychological (and sociological) experiments, participants are usually asked to give their stated preferences.

[3] In addition to a participant's age, the Statistics Laboratory also asked for gender.

[4] When two adults in a household participated, the Statistics Laboratory talked separately to them to obtain a commitment to participate, and they were told that they would be assigned to different groups.

[5] The complete set of instructions given to participants is available from the authors.

[6] If one assumes that there is little or no income effect from the deck of cards and box of pens, the two bids on the candy bar should be the same. The reason is that since the deck of cards and box of pens are neither complements nor substitutes to the candy bar, they should not impact the bids on the candy bar. A Wilcoxon signed-rank test confirmed that the bids for the candy bars are not significantly different in the two rounds, with a test statistic of 0.03. This result does not contradict the notion that the subjects' bidding behavior was reasonable.

[7] When a participant received both pro-biotechnology and anti-biotechnology information, the order was randomized, so that some people got the pro-biotechnology information first, and some people got the anti-biotechnology information first.

[8] When verifiable information was distributed, monitors always distributed it after the other information sources.

[9] We randomized the sequencing of the standard food and GM-labels across experimental units. One unit had the standard label in round 1, and GM-label in round 2. The second unit had the GM-label in round 1, and the standard label in round 2.

[10] A model of differences removes all variables that have coefficients that are the *same* in price equation for plain- and GM-labeled food.

[11] The differences-of-difference comparisons across products is appropriate here because the person is held constant.

[12] Also, marital status, race, education, and age did not have coefficients that were significantly different from zero.

Figure 1: Steps in the experiment

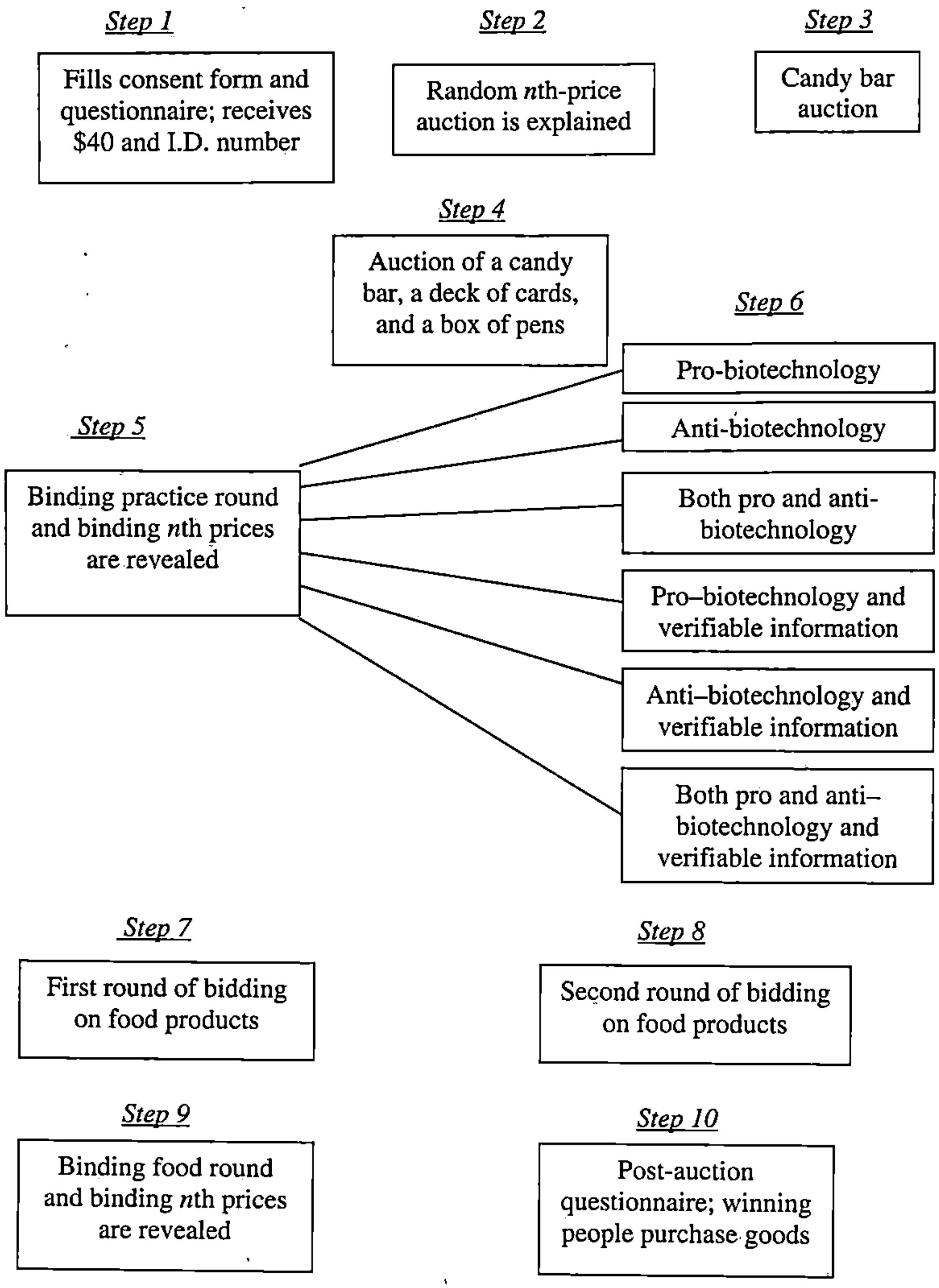

Figure 2: Anti-biotechnology information

The following is a collection of statements and information on genetic modification from Greenpeace, a leading environmental group.

General Information

Genetic modification is one of the most dangerous things being done to your food sources today. There are many reasons that genetically modified foods should be banned, mainly because unknown adverse effects could be catastrophic! Inadequate safety testing of GM plants, animals, and food products has occurred, so humans are the ones testing whether or not GM-foods are safe. Consumers should not have to test new food products to ensure that they are safe.

Scientific Impact

The process of genetic modification takes genes from one organism and puts them into another. This process is very risky. The biggest potential hazard of genetically modified (GM) foods is the unknown. This is a relatively new technique, and no one can guarantee that consumers will not be harmed. Recently, many governments in Europe assured consumers that there would be no harm to consumers over mad-cow disease, but unfortunately, their claims were wrong. We do not want consumers to be harmed by GM-food.

Human Impact

Genetically modified foods could pose major health problems. The potential exists for allergens to be transferred to a GM-food product that no one would suspect. For example, if genes from a peanut were transferred into a tomato, and someone who is allergic to peanuts eats this new tomato, they could display a peanut allergy.

Another problem with genetically modified foods is a moral issue. These foods are taking genes from one living organism and transplanting them into another. Many people think it is morally wrong to mess around with life forms on such a fundamental level.

Financial Impact

GM-foods are being pushed onto consumers by big businesses, which care only about their own profits and ignore possible negative side effects. These groups are actually patenting different life forms that they genetically modify, with plans to sell them in the future. Studies have also shown that GM crops may get lower yields than conventional crops.

Environmental Impact

Genetically modified foods could pose major environmental hazards. Sparse testing of GM plants for environmental impacts has occurred. One potential hazard could be the impact of GM crops on wildlife. One study showed that one type of GM plant killed Monarch butterflies.

Another potential environmental hazard could come from pests that begin to resist GM plants that were engineered to reduce chemical pesticide application. The harmful insects and other pests that get exposed to these crops could quickly develop tolerance and wipe out many of the potential advantages of GM pest resistance.

Figure 3: Pro-biotechnology information

The following is collection of statements and information on genetic modification provided by a group of leading biotechnology companies, including Monsanto and Syngenta.

General Information

Genetically modified plants and animals have the potential to be one of the greatest discoveries in the history of farming. Improvements in crops so far relate to improved insect and disease resistance and weed control. These improvements using bioengineering/GM technology lead to reduced cost of food production. Future GM-food products may have health benefits.

Scientific Impact

Genetic modification is a technique that has been used to produce food products that are approved by the Food and Drug Administration (FDA). Genetic engineering has brought new opportunities to farmers for pest control and in the future will provide consumers with nutrient enhanced foods. GM plants and animals have the potential to be the single greatest discovery in the history of agriculture. We have just seen the tip of the iceberg of future potential.

Human Impact

The health benefits from genetic modification can be enormous. A special type of rice called "golden rice" has already been created which has higher levels of vitamin A. This could be very helpful because the disease Vitamin A Deficiency (VAD) is devastating in Third World countries. VAD causes irreversible blindness in over 500,000 children and is also responsible for over one million deaths annually. Since rice is the staple food in the diets of millions of people in the Third World, golden rice has the potential of improving millions of lives a year by reducing the cases of VAD.

The FDA has approved GM-food for human consumption, and Americans have been consuming GM-foods for years. While every food product may pose risks, there has never been a documented case of a person getting sick from GM-food.

Financial Impact

Genetically modified plants have reduced the cost of food production, which means lower food prices, and that can help feed the world. In America, lower food prices help decrease the number of hungry people and also let consumers save a little more money on food. Worldwide the number of hungry people has been declining, but increased crop production using GM technology can also help further reduce world hunger.

Environmental Impact

GM technology has produced new methods of insect control that reduce chemical insecticide application by 50 percent or more. This means less environmental damage. GM weed control is providing new methods to control weeds, which are a special problem in no-till farming. Genetic modification of plants has the potential to be one of the most environmentally helpful discoveries ever.

Figure 4: Independent, verifiable information

The following is a statement on genetic modification approved by a third party group, consisting of a variety of individuals knowledgeable about genetically modified foods, including scientists, professionals, religious leaders, and academics. These parties have no financial stake in genetically modified foods.

General Information

Bioengineering is a type of genetic modification where genes are transferred across plants or animals, a process that would not otherwise occur. (In common usage, genetic modification means bioengineering.) With bioengineered pest resistance in plants, the process is somewhat similar to the process of how a flu shot works in the human body. Flu shots work by injecting a virus into the body to help make a human body more resistant to the flu. Bioengineered plant-pest resistance causes a plant to enhance its own pest resistance.

Scientific Impact

The Food and Drug Administration standards for GM-food products (chips, cereals, potatoes, etc.) are based on the principle that they have essentially the same ingredients, although they have been modified slightly from the original plant materials.

Oils made from bioengineered oil crops have been refined, and this process removed essentially all the GM proteins, making them like non-GM oils. So even if GM crops were deemed to be harmful for human consumption, it is doubtful that vegetable oils would cause harm.

Human Impact

While many genetically modified foods are in the process of being put on your grocers' shelf, there are currently no foods available in the U.S. where genetic modification has increased nutrient content.

All foods present a small risk of an allergic reaction to some people. No FDA approved GM-food poses any known unique human health risks.

Financial Impact

Genetically modified seeds and other organisms are produced by businesses that seek profits. For farmers to switch to GM crops, they must see benefits from the switch. However, genetic modification technology may lead to changes in the organization of the agri-business industry and farming. The introduction of GM-foods has the potential to decrease the prices to consumers for groceries.

Environmental Impact

The effects of genetic modification on the environment are largely unknown. Bioengineered insect resistance has reduced farmers' applications of environmentally hazardous insecticides. More studies are occurring to help assess the impact of bioengineered plants and organisms on the environment. A couple of studies reported harm to Monarch butterflies from GM crops, but other scientists were not able to recreate the results. The possibility of insects growing resistant to GM crops is a legitimate concern.

Figure 5: GM- and standard labels used for the three food items

Russet Potatoes *Net weight 5 lb.* **This product is made using genetic modification (GM).**	**Russet Potatoes** *Net weight 5 lb.*
Tortilla Chips *Net weight 16 oz.* *Fresh made Thursday April 5th* **This product is made using genetic modification (GM).**	**Tortilla Chips** *Net weight 16 oz.* *Fresh made Thursday April 5th*
Vegetable Oil *Net weight 32 fl. oz.* **This product is made using genetically modified (GM) soybeans.**	**Vegetable Oil** *Net weight 32 fl. oz.*

Table 1. Characteristics of the auction participants

Variable	Definition	Mean	St. Dev
Gender	1 if female	0.62	0.49
Age	The participant's age	49.5	17.5
Marital Status	1 if the individual is married	0.67	0.47
Education	Years of schooling	14.54	2.25
Household	Number of people in participant's household	2.78	1.65
Income	The households income level (in thousands)	57.0	32.6
Race	1 if participant is white	0.90	0.30
Labels	1 if never read labels before a new food purchase	0.01	0.11
	1 if rarely read labels before a new food purchase	0.11	0.31
	1 if sometimes read labels before a new food purchase	0.31	0.46
	1 if often read labels before a new food purchase	0.37	0.48
	1 if always read labels before a new food purchase	0.20	0.40

Table 2. Mean bids

A. Mean bids – all participants

	Observations	mean bid	std dev	Minimum	Maximum
GM OIL	172	0.91	0.84	0	3.99
OIL	172	1.05	0.85	0	3.79
GM CHIPS	172	0.93	0.86	0	3.99
CHIPS	172	1.08	0.85	0	4.99
GM POTATOES	172	0.78	0.67	0	3
POTATOES	172	0.91	0.67	0	3.89

B. Mean bids when participants bid on food with GM-food labels in round 1

	Observations	mean bid	std dev	Minimum	Maximum
GM OIL	88	0.98	0.91	0	3.99
OIL	88	1.04	0.89	0	3.79
GM CHIPS	88	0.95	0.87	0	3.25
CHIPS	88	1.05	0.81	0	2.99
GM POTATOES	88	0.90	0.69	0	2.5
POTATOES	88	0.94	0.63	0	2.51

C. Mean bids when participants bid on food with GM-food labels in round 2

	Observations	mean bid	std dev	Minimum	Maximum
GM OIL	84	0.83	0.77	0	3.25
OIL	84	1.06	0.80	0	3
GM CHIPS	84	0.90	0.86	0	3.99
CHIPS	84	1.11	0.89	0	4.99
GM POTATOES	84	0.65	0.63	0	3
POTATOES	84	0.88	0.72	0	3.89

Table 3. Vegetable Oil: OLS estimates of models explaining difference in bid prices for GM-labeled and standard-labeled vegetable oil (n=172)

Dependent variable: Bid price non-labeled food – bid price GM-labeled food [1]

Regressors	(1)	(2)	(3)	(4)	(5)
Intercept	0.143 **	0.231 **	0.028	0.207 **	0.093
	(0.043)	(0.061)	(0.087)	(0.070)	(0.106)
Labels1		-.173 *			
		(0.085)			
Income			0.0020		0.0019
			(0.0013)		(0.0013)
Gender				-0.104	-0.0947
				(0.089)	(0.089)
R^2	N.A.	.024	.014	.008	.020

[1]Estimate of coefficients with standard errors in parentheses
** indicates that a variable is significant at 1%
* indicates that a variable is significant at 5%

Table 4. **Tortilla Chips: OLS estimates of models explaining difference in bid prices for GM-labeled and standard-labeled tortilla chips (n=172)**

Dependent variable: Bid price non-labeled food – bid price GM-labeled food[1]

Regressors	(1)	(2)	(3)	(4)	(5)
Intercept	0.152 **	0.206 **	0.088	0.173 **	0.108
	(0.037)	(0.053)	(0.075)	(0.061)	(0.092)
Labels1		-0.106			
		(0.075)			
Income			0.0011		0.0011
			(0.0012)		(0.0012)
Gender				-0.034	-0.0285
				(0.077)	(0.0775)
R^2	N.A.	.012	.006	.001	.006

[1]Estimate of coefficients with standard errors in parentheses
** indicates that a variable is significant at 1%
* indicates that a variable is significant at 5%

Table 5. **Potatoes: OLS estimates of models explaining difference in bid prices for GM-labeled and standard-labeled potatoes (n=172)**

Dependent variable: Bid price non-labeled food – bid price GM-labeled food[1]

Regressors	(1)	(2)	(3)	(4)	(5)
Intercept	0.132 ** (0.032)	0.229 ** (0.045)	0.09 (0.065)	0.139 ** (0.053)	0.094 (0.080)
Labels1		-0.189 ** (0.630)			
Income			0.0007 (0.0010)		0.0007 (0.0010)
Gender				-0.0103 (0.0666)	-0.0067 (0.0668)
R^2	N.A.	.050	.003	.000	.003

[1]Estimate of coefficients with standard errors in parentheses
** indicates that a variable is significant at 1%
* indicates that a variable is significant at 5%